Today's Lecture 2/18/09

Chapter 7.1:

- Symbolizing English Arguments
- 5 Important Logical Operators

Validity

- An argument is *valid* =df it is not possible to have true premises and a false conclusion.

- An argument is *invalid* =df

it is possible to have true premises and a false conclusion.

- Recall, we used the counter-example method to show that an argument is invalid.

- For example, we saw that

1. If it rained last night, then my car is wet
2. It is false that it rained last night.
3. So it is false that my car is wet.

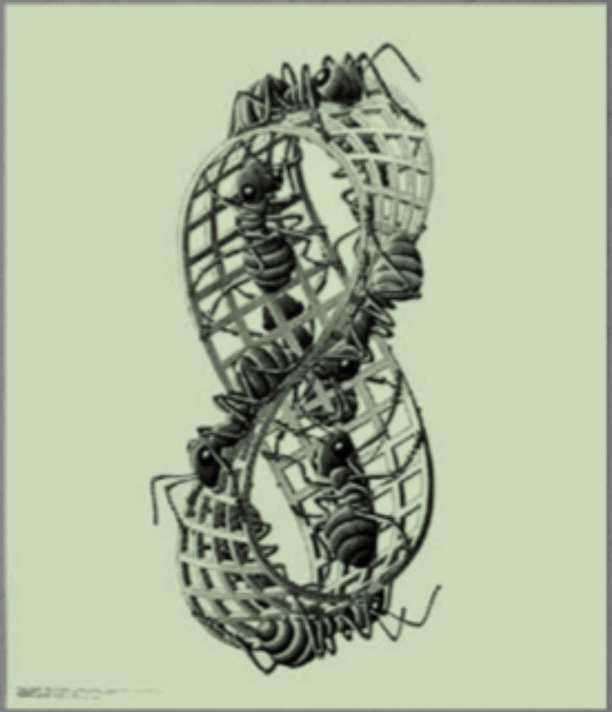
is an invalid argument because it is of this form:

1. If P, then Q.
2. It is false that P.
3. So it is false that Q.

- That form has invalidating instances. Let P: Paris is in California. Let Q: California has a big city. These result in true premises and a false conclusion.

But this method is limited

- For more complicated arguments, it is not easy to come up with substitutions that show it to be invalid.
- Why?
  - Sometimes the argument is in fact valid, so it is impossible to come up with a substitution that makes it invalid (we just don't see it).
  - Sometimes our creative powers are limited; we just can't imagine a good counterexample but there is



- So we will be studying two different mechanical methods for determining whether an argument is valid or invalid.
- 1st Method: Truth Tables (ch. 7)
- 2nd Method: Proofs (ch. 8)
- This material will occupy us the rest of the quarter

Symbolizing English Arguments

7.1 (p. 277-298)

Our Strategy

- Step One: Learn how to represent argument forms using a symbolic notation.
- Step Two: Apply rigorous tests to determine if an argument form is Valid or Invalid.
  - (Truth Tables & Proofs)

Charles Sanders Pierce
(1839-1914)

Atomic vs. Compound Statements

- An **atomic statement** is one that does not have any other statement as a component.

  Examples
  - Grass is green.
  - The UCen is next to the lagoon.
  - Life is good.

- A **compound statement** is one that has at least one atomic statement as a component.

  Examples
  - It is false that grass is purple.
  - The UCen is next to the lagoon and I am hungry.
  - If life is good, then we have a reason to celebrate.

Atomic Statements

Symbolize Atomic Statements with a single upper case letter.

B: Burritos are tasty.

C: Cupid has bad aim.

N: Neil Gaiman wrote *Caroline* .

T: Thought is mysterious.

- These assignments are called Schemes of Abbreviation.

Compound Statements

Symbolize Compound Statements by first Symbolizing their Atomic Constituents.

It is false that *grass is purple* .

It is false that G.

The UCen is next to the lagoon and *I am hungry* .

U and I

If *life is good* , then *we have reason to celebrate* .

Symbolizing the Logical Words

Operator	Name	Translates	Compound Type
~	tilde	not	negation
□	dot	and	conjunction
□	vee	or	disjunction
□	arrow	if-then	conditional
□	double-arrow	if and only if	biconditional

If you don’t memorize what these stand for you will fail the final!

Negations

~

Symbolizing Negations

Grass is not purple. (P: Grass is purple)

is symbolized as

~ P

It is not the case that grass is purple

is symbolized as

~ P

It is false that grass is purple

is symbolized as

~ P

Negations of Compound Statements

- It is false that Obama wins and McCain wins

is symbolized as

~ (O □ M) O: Obama wins

M: McCain wins

- It's not true that if Obama wins, then McCain wins

is symbolized as

~ (O □ M)

- The following is false: either Obama wins or McCain wins.

is symbolized as

~ (O □ M)

(Parentheses Matter!)

Consider

- It is false that Obama wins and McCain wins

If we didn’t use parentheses we would get:

- ~ O □ M
  - (this says that Obama does not win and McCain wins)

Consider

- It is false that if Obama wins then McCain wins

If we didn’t use parentheses we would get:

- ~ O □ M
  - (this says that if Obama does not win, then McCain wins; which says something different than it is false that, if Obama wins, then McCain wins.)

Main Logical Operators

- The Main Logical Operator in a compound statement is one that governs the largest component(s) of a compound statement.

- In all these:
  - ~ (O □ M)
  - ~ (O □ M)
  - ~ (O □ M)

the main logical operator is the ~ .

Conjunctions

Symbolizing Conjunctions

Grass is purple and life is good. (P: Grass is purple, L: Life is good)

P □ L

Grass is purple but life is good.

P □ L

Grass is purple yet life is good.

P □ L

Stylistic variants of 'and'

(P: Grass is purple, L: Life is good)

- Grass is purple *but* life is good.
- Grass is purple; *however* life is good.
- Grass is purple *yet* life is good.
- *Although* grass is purple, life is good.
- *While* grass is purple, life is good.
- Grass is purple; *nevertheless* life is good.

P □ L

Not all uses of 'and' are conjunctions

- Sometimes ‘and’ indicates temporal order
- Sarah cracked the safe and took the money.
- You made a joke and I laughed.

- Sometimes ‘and’ indicates a relationship
- Phil and Rachel are engaged.
- Alex and Chris moved the safe.

These are all Conjunctions

P □ Q

P □ ~(Q □ R)

(P □ Q) □ (Q □ P)

~P □[Q □ (R □ S)]

[Q □ (P □ R)] □ S

(P □ Q) □(R □ S)

Disjunctions

Symbolizing Disjunctions

Grass is purple or life is good. (P: Grass is purple, L: Life is good)

P □ L

Grass is purple and/or life is good.

P □ L

Grass is purple or life is good(or both).

P □ L

Grass is purple unless life is good.

P □ L

Inclusive OR

Either P or Q (or both)

Sometimes when people make a disjunctive claim, they intend the ‘or’ to be read inclusively.

e.g.

If you want to live under my roof, either you get a job or you go to college.

**The parent will not be bothered if you do both.

Exclusive OR

Either P or Q (and not both)

Sometimes when people make a disjunctive claim, they intend the ‘or’ to be read exclusively.

e.g.

You may have the soup or you may have the salad.

**The waitress will be bothered if you say ‘both’.

Logicians Treat OR as Inclusive

- We have the resources to symbolize exclusive OR if a context indicates that the OR is exclusive.
- “Either you have the soup or you have the salad, but not both” can be symbolized as

  S: You have the soup, L: You have the salad

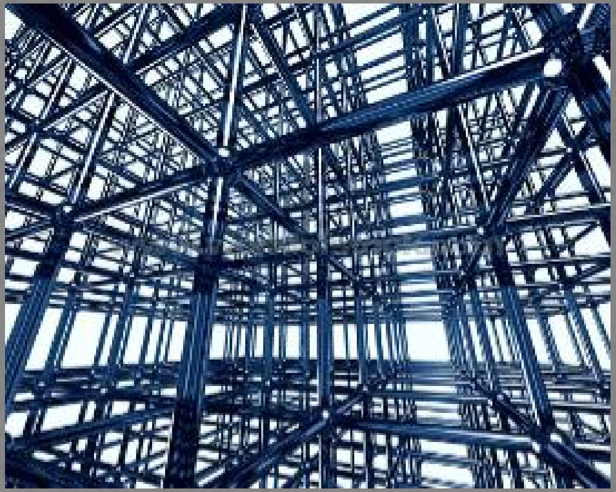
  (S □ L) □ ~(S □ L)

'Neither-Nor' is Not a Disjunction!

Neither Bob nor Sue is content.

B: Bob is content.

S: Sue is content.



Two Equivalent Readings

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1. ~ (B □ S)

1. ~B □ ~S

These are all Disjunctions

P □ Q

P □ ~(Q □ R)

(P □ Q) □ (Q □ P)

~P □[Q □ (R □ S)]

[Q □ (P □ R)] □ S

(P □ Q) □(R □ S)